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1954

Information for graduate students

in Chemistry and
Chemical Engineering

UNIVERSITY OF ILLINOIS

Urbana, Illinois

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INTRODUCTION

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The Department of Chemistry and Chemical Engineering at the University of Illinois consists of six divisions, analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, physical chemistry, and chemical engineering, each offering courses of study and opportunities for graduate research. This information booklet has been prepared to assist graduate students in chemistry and chemical engineering to become better acquainted with the regulations governing graduate study and with the facilities that are available. It is not intended to replace the regular Graduate College Bulletin, but is designed to summarize the most important procedures, with particular reference to those requirements that are peculiar to the Department of Chemistry and Chemical Engineering and not necessarily applicable throughout the University. Since the Department has established a number of regulations in addition to those of the Graduate College, it is important that the student become acquainted with them.

Many questions that arise in the minds of prospective students and students in residence are answered in this booklet. Of course, every student should feel free to consult with faculty members for further information and advice, especially in connection with matters not treated here. Inquiries by mail should be addressed to the Head of the Department of Chemistry and Chemical Engineering, Noyes Laboratory of Chemistry, Urbana, Illinois.

The plan of this booklet follows roughly the chronological order in which problems arise, from admission to the final oral examination for the doctorate. A miscellaneous information section describes the special facilities and services of the Department.

U. S. M. I. I.

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ADMISSION

Admission Requirements

Application for admission to the University of Illinois must be made directly to the Director of Admissions, University of Illinois, Urbana, Illinois. Admission to the Department of Chemistry and Chemical Engineering through the Director of Admissions is generally granted to any student graduating from an accredited college or university whose record is not below a 4.0 (B) average for all courses completed during the last fifty per cent of his undergraduate work. Since this record cannot be precisely determined until the final transcript of credits is available, the Director of Admissions usually incorporates in his reply to the student the following statement: "No action can be taken on your application until you have completed your work at . . . (name of school) . . . and a final transcript of your record and certification of your degree has been received from the Registrar of that institution." Any student receiving such a statement who fulfills the grade average requirements stated above will be admitted.

Prospective students who apply for assistantships or fellowships before they have completed their undergraduate work will generally be advised of the action taken by the University before the end of the academic year. If the student's record at date of application is such that there is little doubt about admission being granted upon receipt of his complete transcript, he may receive an appointment prior to his graduation contingent only on his finally fulfilling the required average for his last two years of undergraduate work.

Students who have completed graduate work in chemistry or chemical engineering and related subjects at another institution may be admitted provided (1) their undergraduate records meet the above requirements and (2) their grade-point averages in graduate work are at least 4.0. Students whose undergraduate records have not met the above requirements

must have earned a 4.25 average in at least eight units or a full year of graduate work in order to be admitted to the Graduate College in chemistry and chemical engineering.

The course requirements for admission to the Graduate College in chemistry and chemical engineering are somewhat flexible, and deficiencies usually can be made up during the first year of graduate work. However, to become a candidate for an advanced degree, students must meet certain basic requirements and it is highly desirable that these be satisfied by the courses presented for admission. The details will be found in later sections, but the following is a summary of the course work at the undergraduate college level required of students who expect to become candidates for advanced degrees in chemistry or in chemical engineering.

Chemistry. Twenty-five hours in chemistry properly distributed; a year or more of physics; mathematics through differential and integral calculus; and a year of French or German (preferably German). If the applicant has completed two or three years of work in French or German in secondary school, the requirement will be considered to be met, provided at least one additional semester of the language has been done in college. Four years of French or German in the secondary school will be accepted without any additional college work in the subject. An applicant with knowledge of French or German, but lacking formal credentials, may take an examination to determine his status.

Chemical Engineering. Twenty-five hours in chemistry including organic and physical chemistry; the usual courses in physics, mechanics, electrical engineering, and chemical engineering; mathematics through differential and integral calculus. Students who enter without the usual engineering courses prescribed in the undergraduate chemical engineering curriculum will be required to make up their principal deficiencies as prescribed by their adviser. Courses in French and German are recommended but not required.

Admission with Advanced Standing

A student who has done graduate work in another approved institution may transfer credit (at least in part) toward advanced degrees at the University of Illinois. The detailed condi-

tions governing such transfers are given in the Graduate College Bulletin, and can be summarized as follows. If a student carries on graduate work elsewhere but does not obtain a master's degree, he must petition the Dean of the Graduate College to have the transferred credit applied toward a master's or doctor's degree. Written examinations will be required to determine the student's proficiency in the subjects requested for transfer. If a student has received a master's degree, no examinations are necessary before official transfer of one year of residence credit. However, if the student fails to do creditable work at the University of Illinois, the residence credit for his master's work may be withdrawn. Entering with a master's degree reduces the residence requirements for the doctor's degree by one year (i.e., from three years to two years). However, the specific major and minor requirements are such that only under exceptional circumstances will it be possible for such a student to complete his doctorate work in the minimum two year residence period.

Registration Examinations

All students who receive permits to enter the Graduate College in chemistry and chemical engineering, including those who may have had training beyond the bachelor's degree, must take registration examinations. These are offered two or three days prior to graduate registration in September, February, and June.

The purpose of these examinations is to assist the Department in evaluating the background of the new students so that they may be registered in courses for which they are adequately prepared. The results of these examinations are not recorded permanently nor do they in any way affect the status of the student in regard to admission, teaching and research appointments, or fellowships.

Each new graduate student, whether entering with a bachelor's or master's degree, is required to take four registration examinations. Those

who intend to major in chemistry must take examinations covering undergraduate instruction in inorganic, analytical, organic, and physical chemistry. A student who intends to specialize in chemical engineering must take the examination in physical chemistry and in one other field of chemistry selected by the student; in addition, he must take examinations in chemical engineering, one covering stoichiometry and fluid flow, the other heat and mass transfer.

Students who demonstrate through these examinations a lack of adequate training in any of the fields indicated will be required to make up the deficiency by taking the appropriate advanced undergraduate courses. These are Chemistry 315 (inorganic), 325 (analytical), 234 and/or 336 (organic), 240 and/or 342 (or 440) (physical). All of these courses (except Chemistry 234 and 240) carry graduate credit. Chemical engineering majors may be required to take one or more of the following courses: Chemical Engineering 371, 373, and 377; these all carry graduate credit.

Students who have received permits to enter the Graduate College will receive from the Department a notice of the dates when these registration examinations will be given.

Registration Procedure

The details of registration procedure are described in the Graduate College Bulletin. However, a few comments about the situation in the Department of Chemistry and Chemical Engineering will be made here. The Head of the Department is the official adviser for all graduate students. During the graduate registration period each student must consult with the Head of the Department for final approval of his program for the semester. However, those students who have decided on their major field should first discuss their course of study and related problems with faculty members in that field and arrange a tentative schedule before seeking the approval of the

Head of the Department. Staff members will be given the results of the registration examinations and will be available to help any student with registration problems.

Tuition and Fees

Students who are on the academic staff of the University (e.g., teaching and research assistants) and most of those who hold fellowship appointments are exempt from the payment of the tuition and the laboratory, library and supply fees.

All other students registering for resident work must pay fees each semester and summer session. For a full-time student who is a resident of Illinois, these amount to \$73.00 each semester, for nonresidents, \$183.00 each semester. In this connection it should be noted that students who are self-supporting and live in Illinois for one year can qualify as residents of the state by making application at the Recorder's office. Students taking two units (half-time) or less of resident work pay a lower fee.

APPOINTMENTS FOR GRADUATE STUDENTS

Two general classes of appointments are available for graduate students, namely, assistantships and fellowships. A student is free to apply for more than one appointment, but is permitted to accept only one. Graduate assistants are employees of the University and are required to perform certain duties either in teaching or research, as specified by their appointments. Assistants are generally employed on a half-time basis, but appointments for different amounts of time can be made. Half-time assistants are permitted to register for three-quarters of a normal graduate load, but under special circumstances this limitation may be removed for research assistants. University staff members, including assistants, with salaries less than \$2,700 for the academic year or \$3,300 for twelve months are exempt from tuition

payments, but their salaries are subject to federal income tax.

Holders of fellowships are not considered employees of the University and are not required to perform any specific duties. However, fellows are expected to devote full time to furthering their training with particular emphasis on research during their second and third years of residence. Fellowship stipends, which are considered gifts, are not subject to tax, but fellows may be required to pay tuition if the donor has not made provision for the same. (All University sponsored fellowships and most industrial fellowships provide tuition in addition to the stipend.)

Fellowship and assistantship application forms are not the same and students applying for both must fill out two forms. However, one assistantship application form is sufficient for a student applying for both teaching and research assistantships, provided the applicant indicates his wish to be considered for both kinds of assistantships. Likewise one fellowship application form is sufficient for applying for more than one fellowship if accompanied by an appropriate statement of intent. Each kind of application normally requires an official transcript, but if a student applies for both an assistantship and fellowship, he may substitute an unofficial copy of his record to accompany his *assistantship* application. However, at least one official transcript in addition to that required by the Director of Admissions must be sent to the University by the Registrar of the student's college or university with his application for a fellowship or assistantship.

Every student applying for more than one kind of appointment (fellowship, research assistantship, or teaching assistantship) should inform the Head of the Department of Chemistry and Chemical Engineering of his order of preference. A candidate unsuccessful for one kind of appointment might receive another, consistent whenever possible with the student's preference.

Teaching Assistantships

Teaching assistants are employed to help senior staff members carry on instruction. The specific duties include laboratory supervision, grading of papers, proctoring of examinations, or conducting quizzes and recitations. Application blanks can be obtained from the Department of Chemistry and Chemical Engineering, and the applications and all correspondence pertaining to them should be addressed to the Department. Teaching appointments are made for the academic year of approximately nine months duration. A few summer positions are available but only for students who have been in residence during the preceding year. Half-time teaching assistantships usually require twelve hours a week of service.

Research Assistantships

The Department of Chemistry and Chemical Engineering has a number of research projects that are supported in whole or in part from funds received from federal agencies, industrial concerns, or the University itself. These projects offer opportunities for employment of graduate students as research assistants, usually on an unrestricted basis, but sometimes restricted with respect to the general field of specialization. Funds from the National Science Foundation, U. S. Public Health Service, and other agencies are frequently granted to staff members to enable them to employ research assistants to work on their particular problems. Applications for research assistantships should be sent to the Head of the Department, or directed to the attention of the staff member with whom the student would carry on his work. Research assistantship salaries are computed on approximately the same monthly basis as those for teaching assistantships, but the period of service is variable.

Research assistantships in chemical engineering are also available through the Engineering Experiment Station. Inquiries concerning these assistantships should be addressed to the Divi-

sion of Chemical Engineering, 114 East Chemistry Building, Urbana, Illinois.

University Fellowships

University Fellowships are administered by the Graduate College and application forms can be obtained from that College. Such applications are then referred to the Department, which makes its recommendations to the College. Final selection of University fellows is made by a Graduate College committee which examines applications from all departments.

Fellowship appointments are for the academic year, and summer fellowships are generally not available. However, a University fellow is exempt from tuition payments during the summer immediately following his academic year of appointment.

Special Fellowships

In addition to University sponsored fellowships, there are available to graduate students in the Department of Chemistry and Chemical Engineering a number of special fellowships supported principally by the chemical industry. The special fellowships generally carry higher stipends than University Fellowships, and are usually offered to second and third year resident students or to students entering with master's degrees. Nominations for special fellowships are approved by the Graduate College, provided the student's record qualifies him for a recommendation by the Department for a University Fellowship.

Students are reminded that the National Science Foundation as well as other non-university agencies also award fellowships, but applications must be made directly to those agencies.

MASTER'S DEGREES

The Department of Chemistry and Chemical Engineering offers courses of study leading to the degrees of Master of Arts or Master of

Science in Chemistry and Master of Science in Chemical Engineering.

Residence

A master's degree requires eight units of graduate credit with satisfactory grades which must be earned during not less than two semesters of residence. A minimum registration of two units in a regular semester is necessary to establish residence for that semester. Registration for not less than one unit of work in each of two summer sessions will be accepted as the equivalent of one regular semester in residence. Registration for more than two units in a regular semester, or for more than one unit in a summer session, will not change the minimum time required to discharge the residence requirements.

Credit Requirements

All candidates for master's degrees in chemistry or in chemical engineering must present credit for one semester of physical chemistry (Chemistry 240 and 241 or the equivalent). In addition, chemical engineering students are required to take Chemical Engineering 487 and 488.

Of the eight units of graduate credit required for the master's degree at least four must be in chemistry or chemical engineering. The rest may be in the major or in one or two minor fields, although it is not necessary to declare a minor. At least three units at the 400 level (courses open to graduate students only) are required, and at least two of these units must be in chemistry or chemical engineering. Students studying for the master's degree do not have to choose a special field of chemistry or chemical engineering for their major.

There is no foreign language requirement for a master's degree. However, since candidates for the Ph.D. degree in chemistry or chemical engineering must pass one language examina-

tion before receiving second-year residence credit, it is advisable for students to pass one language examination during their first year of graduate work.

Transfer of Credit

A student who has taken graduate work at another approved institution may petition to obtain credit toward the master's degree in an amount not exceeding four units, subject to passing examinations in the work. Such substitution is permitted only when the work taken elsewhere is substantially equivalent to course offerings at the University of Illinois. Admission to such examinations requires the prior approval of the Head of the Department and the Dean of the Graduate College. The acceptance of credit for work completed elsewhere does not reduce the residence requirement of two semesters.

Thesis

The requirement of the thesis for the master's degree may be waived on the recommendation of the Head of the Department of Chemistry and Chemical Engineering. A student excused from writing a thesis must replace it with courses of instruction. If any credit in research is used toward the master's degree, the preparation of a thesis is mandatory. If candidates for the M.S. or A.M. degrees prepare a thesis, it is usually based on two or two and one-half units of credit in research (Chemistry 490 or Chemical Engineering 490) as part of the master's program. Not more than three units of research credit may be applied toward a master's degree. The subject of the thesis must be filed at the Graduate College office by the student not later than the registration period prior to his graduation. For specific instructions with reference to the preparation and form of the thesis, the student should obtain from the Graduate College office a copy of the leaflet "Instructions for Preparation of Theses." Two copies of the thesis with a Certif-

icate of Approval must be presented to the Graduate College office by the date specified in the calendar of the Graduate College. The Certificate of Approval for the master's thesis must be signed by the person under whose immediate supervision the thesis was prepared and also by the Head of the Department of Chemistry and Chemical Engineering. Consequently the thesis signed by the research supervisor must be in the office of the Head of the Department two days prior to the date when it is due in the Graduate College office. Blank certificate forms can be obtained at the Graduate College office.

DOCTOR'S DEGREES

The department offers courses of study leading to the degrees of Doctor of Philosophy in Chemistry and Doctor of Philosophy in Chemical Engineering.

General Requirements

The degree of Doctor of Philosophy requires twenty-four units of graduate credit with satisfactory grades distributed over at least three years of resident study. The first year includes the completion of eight units of graduate work and the passing of one foreign language examination. The second year includes eight more units of graduate work, the passing of the second foreign language examination, and the passing of the preliminary examination. The final year includes the time spent between the preliminary examination and the completion of all requirements for the doctor's degree, including research, preparation of a satisfactory thesis, and the passing of the final examination.

A candidate for the degree of Doctor of Philosophy pursues a major subject in the field of his research interest: analytical chemistry, biochemistry, inorganic, organic, or physical chemistry, or chemical engineering. He is also required to study at least one minor subject to be selected in accordance with the recommen-

dations appearing below. If a student takes a sole minor, that minor must be in a department outside of chemistry and chemical engineering. As an alternative to a sole minor, a student may take two minors, at least one of which must be outside the Department.

It is desirable that all candidates for the Ph.D. degree in chemistry and chemical engineering have a first or second minor in chemistry or chemical engineering, the exact requirements of which can be ascertained from the heads of the divisions concerned. A student desiring to take a *sole* minor in an outside department must obtain special permission of the Head of the Department of Chemistry and Chemical Engineering unless the sole minor is in one of the following departments: Mathematics, Physics, Electrical Engineering, Mechanical Engineering, Theoretical and Applied Mechanics, or Bacteriology (for those majoring in bioengineering). A student desiring to take a *first* minor in an outside department must obtain special permission of the Head of the Department of Chemistry and Chemical Engineering unless it is in one of the departments listed above. His second minor must then be either in chemistry or chemical engineering or another of the aforementioned departments. In general, the first minor should be in a field of study of a scientific character related to chemistry and chemical engineering. Students may petition to take a first minor in a nonscientific subject provided the second minor is in the Department of Chemistry and Chemical Engineering.

By permission of both the head of the division in which he is registered and the Head of the Department, a student may register for a first minor in two fields of chemistry or chemical engineering. Under normal conditions such a split minor will require four units of work, involving not less than one and one-half units in either division. The written and oral preliminary examinations will cover the content of the courses in which students have been registered.

A student who has a first minor in chemistry or chemical engineering, subject to the approval of the Head of the Department, may take a second minor in any field, scientific or non-scientific, in which he has had undergraduate courses adequate as prerequisites for courses offering graduate credit.

A candidate for the Doctor of Philosophy degree in any branch of chemistry or in chemical engineering must include among his courses at least one year of physical chemistry unless he presents the equivalent as entrance credit. A candidate for the doctorate will also be required to take Chemistry 494, Selected Topics in Chemical Principles, unless he includes in his graduate program at least two units of 400 courses in physical chemistry, excluding Chemistry 440.

Languages

The student will be required to demonstrate his ability to read German and French. A student may substitute Russian for French on the direct recommendation of the Department (and without formal petition).

Any graduate student entering the Department of Chemistry and Chemical Engineering with a bachelor's degree who intends to continue for the doctorate must pass one foreign language examination not later than the first regular semester in which the student registers after he has completed six units of study.

A graduate student entering the Department of Chemistry and Chemical Engineering with a master's degree is urged to take one foreign language examination at the first opportunity following initial registration, and will be required to do so not later than the second time the examination is given in that particular semester. Any student who does not comply with these regulations will receive no further residence credit toward his degree until he passes one language examination.

The second language examination must be taken and passed at least two months before

the student may take the preliminary examination or during the semester (or summer session) preceding that in which he is admitted to the preliminary examination.

A student planning to take a language examination must apply to the Graduate College for the same in accordance with certain dates specified in the Graduate College calendar.

Preliminary Examination

A candidate for the Ph.D. degree must pass a preliminary examination intended to test his knowledge of his major and minor fields of study. He will not be admitted to the examination before (1) he has passed the two required language examinations, (2) he has satisfactorily completed at least sixteen units of graduate work inclusive of all major and minor course requirements, and (3) his research supervisor considers he has achieved adequate results in research so that he may normally complete his thesis after a full additional year of residence. The Department of Chemistry and Chemical Engineering conducts *written* preliminary examinations in major and first minor fields on dates determined and announced by the Department. After passing the written examinations, the candidate is given an *oral* preliminary examination in his major and minor subjects by a committee appointed by the Graduate College. (The committee usually includes two examiners in the major field, two in the first minor, and one in the second minor, or three in the major and two in the sole minor.)

Research and Thesis

A candidate for the doctorate is encouraged to select his research supervisor if possible during the first semester of his graduate study so that he will have the benefit of individual interest and guidance early in his graduate career. Whenever possible, the student should select his research supervisor *before* the beginning of the semester in which he plans to enroll

in research. Selection of a supervisor is made most effectively after a series of personal interviews between the student and members of the faculty in his major division.

A thesis is always required of students working toward the degree of Doctor of Philosophy. The general thesis topic must be announced at the time of the preliminary examination and the thesis title must be signed by the student and the Head of the Department of Chemistry and Chemical Engineering and then filed with the Graduate College three months prior to graduation. The student should register in his thesis course (Chemistry 490 or Chemical Engineering 490) for the number of units corresponding to the amount of time to be devoted to thesis research, four units being the equivalent of full-time work. Four typewritten copies of the final thesis should be provided, two of which become the property of the University, one is for the research supervisor, and one remains the property of the student. Not later than two weeks before the time set for his final examination, the candidate must submit to the Graduate College, for approval of the format, two typewritten copies (original and first carbon) of his thesis accompanied by approval sheets signed by the research supervisor and the Head of the Department. The thesis signed by the research supervisor must be in the office of the Head of the Department two days prior to the time it is due in the Graduate College office. The style and form of the thesis must comply with the regulations given in the leaflet "Instructions for Preparation of Theses," copies of which can be obtained from the Graduate College office. After the two thesis copies have been checked at the Graduate College office, the student must arrange that each member of his doctoral committee has an opportunity to read the thesis before the date of the final examination. At the conclusion of the candidate's final examination, he must deposit the original and first carbon copy of his thesis in the Graduate College office.

Final Oral Examination

When the thesis has been completed and is acceptable to the research supervisor and the Head of the Department, the candidate will be given his final oral examination by his doctoral committee. The final examination must be completed at least two weeks before the degree is to be conferred as specified in the calendar of the Graduate College. This examination is primarily concerned with the research work of the student as embodied in his thesis, but it is also the intention of the examination to establish that the candidate has a satisfactory grasp of his major subject as a whole, and a general acquaintance with the fields of knowledge represented by his course of study.

Abstracts and Publication

The candidate who passes the final examination must pay a fee of \$30.00 and deposit an abstract of his thesis (with approval sheet) of approximately six hundred words, together with the original and first carbon of the complete thesis. This fee will provide for (1) micro-filming of the complete dissertation, with one copy to be deposited in the University of Illinois Library, and (2) publication of the six hundred word abstract in *Dissertation Abstracts*. Reprints of the published abstract, if required by the Department or desired by the student, may be ordered at a cost of \$12.00 per hundred. Abstracts of more than six hundred words will be accepted at an additional cost, details of which can be secured from the Graduate College office. The original records of the investigation and the completed dissertation are the property of the University of Illinois.

MISCELLANEOUS

Special Facilities

The Department of Chemistry and Chemical Engineering is well provided with facilities for graduate research. In addition to the regular laboratories located in three buildings, the



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following special facilities and services are available: Microanalysis, Infrared Spectroscopy, Visible and Ultraviolet Spectroscopy, High Pressure Hydrogenation, Radiocarbon Synthesis Laboratory, Electron Microscopy, X-ray and Electron Diffraction, Ultracentrifuge Laboratory, Electrophoresis Laboratory, Mass Spectrograph, and Polarographic Laboratory.

The Department maintains two shops staffed with professional machinists to make complex research equipment. A fully equipped student shop is available in which students may make simple equipment themselves.

The Department employs a professional glass blower and has a glass blowing shop where glass equipment can be constructed. A repair shop for maintenance of electrical and electronic equipment is also available.

Each division maintains one or more store-rooms where chemicals, glassware, instruments, and supplies may be obtained.

Placement Service

The Department makes every effort to obtain academic and industrial positions for students who have completed their studies.

Representatives of a wide variety of chemical industries come to the Department each year to interview students. The Department has established a placement service to enable the personnel representatives to talk with the students. Interviews are often arranged long before the student expects to finish his graduate training. In this way, every student may learn about several different types of chemical industry and have a sound basis for deciding what kind of job is best for him. In reaching this decision, the advice of interested faculty members is always available to the student.

Housing

Information about University housing can be obtained by writing to the Housing Division, 108 Illini Hall, Champaign, Illinois.